Reflections on Building Great Engineers

By Lieutenant Colonel Paul B. Olsen

Capturing observations has always been part of our military history. Today's engineers are learning historic lessons as our military conducts domestic and overseas contingency operations, and it is imperative that we, as a professional community, capture these lessons for future use. However, the valuable lessons from operational deployments or training exercises often are not captured.

Most United States Army engineers appreciate reading a quality after-action report (AAR) before a project or mission. Our Army knows this and has made significant progress in knowledge management. Indeed, it has been more than 22 years since the establishment of the Center for Army Lessons Learned (CALL), an organization that has amassed an unequaled body of knowledge for the military. Other Services and most Army branches have followed suit. The 249th Engineer Battalion (Prime Power) hosts a collection of electrical lessons learned under *Lion Lessons*, an online body of knowledge named in honor of the battalion's nickname, the Black Lions. With nearly 300 members, *Lion Lessons* is part of the Power and Utilities Operations Professional Forum in the Army's Battle Command Knowledge System.

From field expedient AARs to popular online collaborative sites such as <*www.companycommand.army.mil*>, the official structures for sharing lessons learned still rely on leaders capturing their thoughts and reflections. I have strived to capture a number of observations of military engineering following 20 years of service in the Engineer Regiment, and specifically as the operations officer of the 249th Engineer Battalion, and later as its commander. While the following observations reflect the experiences of a highly specialized unit, I believe they speak more broadly to general engineering and military engineering organizations. Examining lessons learned while serving with some of our nation's most talented military and civilian engineers provides insight into building great engineers.

Observations

Observation 1: Army engineers have always been a full spectrum force.

In Chapter 3 of Field Manual 3-0, *Operations*, is the charge to all field commanders that "the complexity of today's operational environments requires commanders to combine offensive, defensive, and stability [or civil support] tasks."[1] Furthermore, in United States Army Engineer School Commandant Colonel Robert A. Tipton's "Clear the Way" article in the January–April 2009 issue of *Engineer*, we were reminded that " … stability operations require new capabilities and new tactical and technical competencies for engineer Soldiers."[2]

"For years," continued Colonel Tipton, "tasks associated with 'nation building' were to be avoided because [Army engineers] were designed and equipped for high-intensity operations and would only do those other tasks when we

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had to."[3] The Army's new doctrine suggests a return to the importance of specific engineering disciplines, particularly those used during stability operations. It should therefore come as no surprise that leaders of the Army's more technical engineer formations, such as the prime power battalion, would transition easily to this new doctrine. Indeed, for the past decade, United States Army Corps of Engineers (USACE) engineers and prime power units have regularly conducted missions ranging from providing domestic disaster relief operations to providing power to state-of-the-art antimissile systems.

Observation 2: Mother Nature has a vote.

Over the past two years, USACE has deployed specialized units to support 18 natural disasters in the United States. These missions, which were primarily aimed at restoring essential services to Americans in need, required the USACE prime power battalion to keep a number of its platoons on a ready status. These platoons are specially trained and equipped to conduct electrical assessments for USACE while it supports the Federal Emergency Management Agency (FEMA) as cited in the National Response Framework.

As United States Army Northern Command continues to expand its role in domestic operations, more engineer units (especially in the United States Army National Guard) will be called on to respond to domestic disaster operations. Leaders of these engineer units must develop flexibility in their training management systems as quick-response missions arise. The Army's training management cycle centers on locking in quarterly plans and finalizing training schedules six weeks out. Despite the best efforts of commanders and first sergeants to plan, resource, and schedule training, a lot of patience, flexibility, and discipline are required to reschedule this training following a no-notice domestic disaster deployment.

Being ready with trained forces is essential when Mother Nature has her say, and personal experience shows that keeping four prime power platoons readily available—with the ability to surge as many as eight—is the right mix for providing emergency power during the June to November hurricane season. However, when more than four platoons are required, overseas contingency platoon deployments either must be extended, or required electrical training must be put at risk.

Observation 3: The platoon is the key formation for electrical missions.

The first two observations have used the platoon as an illustration because it is a familiar term, and it is the key formation within the prime power battalion. Composed of only 15 noncommissioned officers (NCOs) and led by a warrant officer and a master sergeant, the prime power platoon is unique compared to typical Army engineer platoons. Whereas most platoons are led by a lieutenant and a sergeant first class, the technical complexity of the electrical mission, coupled with the unpredictability of mission occurrence, in truth warrants a warrant officer. Similarly, due to the independent operations required of the prime power platoon, there is no substitute for the experience that comes with a more senior NCO, who regularly must perform the duties of a first sergeant when deployed.

So independent and versatile are these engineer platoons that they are often referred to as "detachments," which may be more descriptive of their modular nature, or as "power stations," a title that gives civilian engineers a better appreciation of their technical function. Regardless of which term is used, there is no better formation than the platoon to conduct worldwide military electrical operations, because it contains the talent and experience needed to accomplish every assigned mission.

It is therefore extremely unfortunate that so few formations exist that are composed purely of engineers of a technical trade group. It is not my intention to take away from the enormous capability within our nation's other engineer formations, but if military engineers are unable to mass our technical skills into formations like platoons and companies, then we will fall short of accomplishing large-scale improvements to infrastructure when called upon. I believe our military would be well served by growing more technical engineering platoons and companies for specific use in conducting "industrial strength" infrastructure missions. Clearly, there are advantages and disadvantages that stem from specialized units, which lead to the next observation.

Observation 4: One is the loneliest number.

The exhilaration of leading the nation's largest formation of military electrical engineers was tempered by the challenge of having led one of its most unique formations. The vast majority of the Army's battalions are subordinate to brigades, divisions, and corps. Due to its unique mission, the Army's prime power battalion reports directly to the commanding general of USACE. The advantages that come with a comparatively independent command are many, but they must be weighed against the disadvantages of managing the complex tasks associated with brigades, divisions, and corps. These include Base Realignment and Closure Commission moves, military construction planning, global communications issues, United States Army Prime Power School (USAPPS) curriculum development, and a host of other tasks. For the most part, these challenges foster a sense of empowerment in subordinate leaders and staff members since senior leaders tackle tough issues such as deployments, restationing, and the construction of new facilities. However, relatively junior officers and NCOs are also tackling tough issues such as the development of power production units for multibillion dollar programs—such as the Theater High-Altitude Area Defense System (THAADS) and Joint Land Attack Cruise Missile Defense Elevated Netted Sensor (JLENS) System—without the assistance of higher-level engineer staffs.

Additionally, a specialized unit often attracts missions tangential to its training because the unit represents the best possible match to meet the requirement. Military

USACE Soldiers provide power to a shelter during disaster relief operations.

planners know this, but are faced with the fact that there are few in-house alternatives readily available.

Task Force SAFE (Safety Actions for Fire and Electricity), the Army's 2008–2009 project to prevent the accidental electrocution of Servicemembers in Iraq, illustrates the challenge. Through the impressive teamwork with the United States Army Materiel Command and USACE, a professional force of more than 100 individual master electricians deployed to theater. However, this force took 90 to 180 days to form, so the initial response by USACE was a prime power platoon. The fit wasn't perfect, and the prime power production specialists required three intense weeks of low-voltage bonding and grounding training before conducting inspections. But their results were impressive, with the platoon completing more than 7,000 electrical compliance inspections, which helped to eliminate additional fatal electrocutions during their time in Iraq.

A quicker and more suitable response might have been to consolidate all the interior electricians assigned to engineer formations already in-theater. These formations could have provided their commanders with a more immediate force to inspect electrical contract work in their areas of operation.

Observation 5: Building great military engineers requires great learning organizations.

To lead a true learning organization, military engineers must be able to influence the development, education, and application of their engineering trades and then be able to make adjustments throughout the entire organization in a cyclical process that must be repeated endlessly. This relationship exists within USACE, where the commandant of USAPPS is also the commander of the Army's prime power battalion. This is an effective relationship, because that officer is able to orchestrate the development of prime power doctrine, the instruction of that doctrine at the school, and the immediate application of this instruction within the battalion. After cycling the resulting lessons learned back into the system, the organization "learns," subsequently building great military engineers.

For example, an AAR written by a prime power battalion platoon leader suggested that his new platoon members, recent USAPPS graduates, were uncomfortable operating the battalion's main medium-voltage generator. A review of the school curriculum revealed an unbalanced emphasis toward Cold War-era models common to industry. The curriculum was adjusted to add a capstone exercise near the end of the course, and all companies in the prime power battalion now report heightened generator readiness.

Observation 6: It' s not <u>what</u> you think; it's <u>how</u> you think.

It is often said that a military trains for certainty and educates for uncertainty. This truism especially applies today to military engineers as they conduct contingency

operations. Skilled engineers, capable of thinking on their feet, are essential during simultaneous offensive, defensive, and stability operations. The battlefield and disaster area successes attributed to our military's prime power engineers are not merely a result of the technical training they receive at USAPPS but also stem from insight that comes with the academic study of physics. Indeed, fully one-third of the school's curriculum is dedicated to the study of mathematics and physics. From this, students understand that the physical world follows a set of laws, and when these laws are internalized, one can master physical concepts such as electricity for immediate application during unpredictable contingency operations. I believe this level of education is best provided by civilian professors and instructors who concentrate on engineer theory (*how to think*), not military training (*what to think*).

To continue to build great electrical engineers across our military, it is also essential to provide young military engineers with continuing education opportunities after graduation from their initial technical training. At the unit level, commanders must plan and resource programs that allow engineers to attend professional association-led training, or trade schooling, with full funding before heading back to technical units for immediate implementation. As with a civilian power company, continuing education is money well spent.

Military engineers must also strive to retain small-unit integrity. Then the time-honored master-apprentice relationship that enables the building of trained and educated engineers for our military will emerge among senior and junior engineers in a unit.

Observation 7: Military engineers are a national asset.

Our military engineers, both in and out of uniform, must be seen as a national asset, and the role of leaders during a crisis is to get them to the decisive place at the decisive time. One of the objectives of the 11 September 2001 attacks was to disrupt our nation's economy. A prime power production specialist arrived in New York from Fort Belvoir, Virginia, within 36 hours of the attack. Sent as part of the USACE initial response, that Soldier directly coordinated with military and civilian leadership and was asked to immediately report to the FEMA director about the utilities powering the three major stock exchanges. His report was later used by President George W. Bush to announce the reopening of those markets.

Prime power production specialists have also proven themselves as a significant counterinsurgency (COIN) weapon. Insurgents aim to discredit governments by disrupting the supply of basic services to the population, so providing those services—especially electricity—is an essential COIN countermeasure. Prime power production specialists, acting as part of Task Force Gold in 2008–2009, provided emergency power to Baghdad's Sadr City, raising the public's trust in the new Iraqi government.

Observation 8: Neither electrons nor insurgents care.

Leading a tactical unit of specialized electrical engineers presents challenges from two deadly threats—the electron and the insurgent. Military electrical engineers must continually weigh the threat of electrocution against the threat of combat and take the proper countermeasures. It's a balancing act of knowing when to don personal protective equipment (PPE) and when to employ a more tactical uniform and equipment. For example, during movement to a reconstruction project such as an energized electrical substation in Sadr City, the uniform should match that of the security force. However, once on the project site, the electrical engineer assumes more risk from his metallic assault rifle and body armor than from the potential small arms fire of an insurgent. In this case, the tactical uniform should be replaced with the appropriate PPE. As Iraq continues to stabilize, this precaution will become more and more prevalent.

It is instructive for military engineers of all trades to apply this lesson to other areas where regulations are in place to protect our safety and equipment. There must always be allowances made for PPE over tactical equipment when the trade risk is higher than the tactical risk.

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Observation 9: Forget the process; get after the problem.

As stated previously, the prime power battalion's emergency deployment to Task Force SAFE was not part of the unit's approved mission statement, and the majority of the tasks conducted during that deployment were better suited for the interior electricians assigned throughout the Services. However, hiding behind doctrinal separations has never been part of the Engineer Regiment's mind-set. A great example was the combined actions of three NCOs who assessed the infrastructure of the Haiditha Dam on the Euphrates River. Rather than ask who was responsible for the dam, the team repaired a backup generator that ultimately restored 200 additional megawatts of reliable power for Baghdad.

Indeed, there are scores of examples of military engineers departing from the constraints of their job and duty descriptions and getting after the real problems of restoring Iraqi and Afghan infrastructure.

Observation 10: Generators are not critical; knowledge is critical.

This observation may appear bizarre coming from a former prime power battalion commander, but I have found it to be true time after time. The battalion's active and war reserve generator fleets are rarely used because contracted power is less expensive, easier to deploy, and more efficient if properly monitored by a qualified military engineer. Given this fact, and the reality that there is not a "one-size-fits-all" power generation package, our military electrical engineer's most valuable skill set is the ability to efficiently plan, execute, and oversee these temporary multimillion-dollar power contracts for specific purposes. The same may be suggested for other technical engineering fields such as water purification and computer networking.

Across our entire government, I see a need to provide engineers and technicians to oversee general and technical engineering contracts including—but not limited to—sewer, water, wastewater, and telecommunications. This is a lesson learned following the devastation wrought by Hurricane Katrina.

Observation 11: Reconstruction and disaster response are painfully similar.

It is striking that the majority of the skills required for reconstruction during overseas contingency operations are the same as those required for domestic disaster responses. The major difference is the source of the destruction to the infrastructure—human as opposed to Mother Nature. For electrical engineers, the jobs performed during Hurricane Katrina reconstruction were the same as those done in Sadr City: electrical load assessments, generator installations, substation maintenance, and others.

The Department of Homeland Defense has a wonderfully comprehensive plan that it uses for disaster response and recovery operations. It also has a similar recovery operations plan for overseas contingency operations authored by the Department of Defense and Department of State. Given the similarity of tasks such as providing water, ice, roofing, and emergency power, it stands to reason that an interagency exchange of lessons would prove valuable for senior government leaders.

Observation 12: Military engineers must remain with the energy vanguard.

We must be ready to employ renewable energy sources, but the real cost savings will come from working our current power infrastructure more efficiently. In Iraq, military engineers are exploring linking solar panels and wind turbines into existing power grids through the use of dormant transformers. They are also partnering with industry to attach fuel cells to our generators. The fuel cells can charge while the generators are running below optimal load, thus avoiding running the generators at a low-load percentage, which has long-run negative effects. The fuel cells would then be discharged while the generators were powered down.

In Afghanistan, fuel cells, solar arrays, and wind turbines show great potential, but the fact remains that all of this equipment must travel through the dangerous Khyber Pass. The safer and more efficient approach would be to optimize our current power generation and distribution methods on enduring bases through better contract oversight. Consider a quote by an executive with an energy management company: "If grocery stores ran like power companies, one would walk down the aisles and there would be no prices on anything. You would fill your cart, get home, and 45 days later you'd get a bill that had a single number on it."

That quote points to the cost of powering diesel plants in Iraq and Afghanistan where we are paying for our power without fully realizing what we are purchasing. On Victory Base in Iraq, for example, I estimated that if the various low-voltage generators (often called *spot generators*) were taken offline and the grid were powered by the central power plants already in place, thousands of 5,000-gallon tankers could be taken off the road and more than $180 million could be saved annually. These types of efficiencies could be realized throughout our theaters through the elimination of spot generation on enduring bases in favor of centralized power plants.

Conclusion

The twelve observations in this article are designed to serve as topics of discussion in military and civilian engineering forums. Although they are presented as individual observations, many are related. They represent a number of truisms that have emerged among the leaders in our community who have served as Black Lions. They are also well in line with meeting the strategic message of the Chief of Engineers, who reminds us that we are "Building Strong," as well as the Engineer School Commandant, who has charged all leaders with the task of "Building Great Engineers." These two challenges have a common thread—a return to educating military engineers in various technical disciplines while preserving the leadership competencies that have allowed our Corps to prevail in both peace and war.

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Endnotes

[1]Field Manual 3-0, *Operations*, 27 February 2008, p. 3-1.

[2]Colonel Robert A. Tipton, "Lead the Way," *Engineer*, January–April 2009, p. 2.

[3]Ibid.